



September 8, 2000

Regional Director
Lower Colorado Region
Attention: Jayne Harkins (LC-4600)
Bureau of Reclamation
PO Box 61470
Boulder City, Nevada 89006-1470

Via fax: (702) 293-8042

Re: Colorado River Interim Surplus Criteria DEIS

Dear Ms. Harkins:

The Pacific Institute for Studies in Development, Environment, and Security respectfully submits the following comments on the Colorado River Interim Surplus Criteria draft Environmental Impact Statement (DEIS). These comments will also be sent to you via regular and electronic mail. The Pacific Institute is an independent, non-partisan, non-profit center in Oakland, California, created in 1987 to conduct research and policy analysis in the areas of environment, sustainable development, and international security. The Institute has actively participated in the development of the Interim Surplus Criteria for more than a year, via formal scoping comments and through informal discussions and workshops. The Pacific Institute also submitted a set of "Environmental Interim Surplus Criteria" for consideration in the DEIS.

The Pacific Institute welcomes the effort to develop interim surplus criteria. We believe that facilitating the implementation of plans and projects to reduce California's use of Colorado River water to its legal apportionment is a worthy objective, and that interim criteria are a reasonable means of achieving this objective. The Institute does not believe, however, that meeting this objective should come at the cost of further harm to the environment.

In the attached comments, the Pacific Institute identifies several major flaws in the DEIS. These include: the failure to analyze the impacts of the 7 State Guidelines (likely to be the preferred alternative); the scope of the document; several of the modeling assumptions; the selection of the 75R trigger as a baseline instead of the flood control trigger; the absence of an adequate cumulative impacts assessment; and a general disregard for the Secretary's responsibility to "protect and enhance the environmental resources of the basin."

The general effect of these deficiencies is to understate the potential environmental impacts of interim surplus criteria. The Pacific Institute concludes that the DEIS is inadequate and should be formally revised and reissued for public comment as a Supplemental Draft Environmental Impact Statement. The deficiencies highlighted in the attached comments are of sufficient magnitude that they preclude a reasonable assessment of the potential environmental impacts associated with the adoption of interim surplus criteria.

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More broadly, the Pacific Institute believes that the potential benefits generated by interim surplus criteria do not warrant their environmental costs. These costs could be substantial. By the year 2015, the flood control alternative would generate a 17% greater probability of flows reaching the delta than would the six states' plan, itself likely to generate more flows than the 7 state plan. Because the frequency and magnitude of such flows are closely tied to the reproduction and health of the native riparian vegetation in the region, and indirectly to the myriad of threatened and endangered species that depend on this habitat, this projected reduction in flows is significant. The projected benefits of the interim surplus criteria are less clear. Interior is promoting the surplus criteria as necessary to reduce California's consumption of Colorado River water. Yet California's plan to reduce its use, even under the most optimistic of projections, would not meet the target conservation objective. And California continues to demand additional water, above and beyond that outlined within the 7 State Plan. At the August 16th AOP meeting, California requested a full surplus declaration for calendar year 2001, including 150,000 acre-feet for agricultural demands, justifying this request as a "transition" into the interim period. The absence of a real "4.4 Plan," combined with California's continued failure to reduce its use, suggest that California will not markedly reduce its use in the next fifteen years. In light of these substantial costs and tentative benefits, there is little incentive to condone increased threats to environmental values along the lower Colorado River.

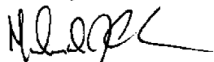
The Secretary of the Interior has stated that surplus flows must be determined and allocated with *no net loss* of environmental benefits. According to the DEIS, the proxy for the 7 State Plan would likely generate a net loss of such benefits. Reclamation should identify a reasonable mechanism for mitigating the loss of such benefits, whether through the releases suggested by the Environmental Criteria or via another mechanism for protecting environmental benefits.

Overall, the Pacific Institute recommends that Reclamation issue a supplemental DEIS that:

1. defines and assesses the potential environmental impacts of the 7 State Guidelines
2. expands the scope to encompass the limitrophe, the delta in Mexico, and the Upper Gulf
3. revises the modeling assumptions as described in the attached comments
4. uses the flood control alternative as the baseline
5. adequately accounts for cumulative impacts
6. assesses the Environmental Interim Surplus Criteria

Thank you for the opportunity to participate in this important process. Please do not hesitate to contact me if you wish to discuss any of the points made in the attached comments.

Sincerely,



Michael Cohen
Research Associate

enclosure

Pacific Institute Comments
on the

Colorado River
Interim Surplus Criteria
Draft Environmental Impact Statement

A report of the

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OVERVIEW

California currently uses about 18% more Colorado River water than its normal entitlement. Until recently, this excess came from the unused apportionments of Arizona and Nevada, the other two states in the lower Colorado River basin. As Arizona and Nevada continue to increase their own use, the federal government and the other basin states have pressured California to reduce its use down to its legal entitlement. In response, California drafted a plan to reduce its use, but claims that over the next 15 years it will require a reliable supply of additional "surplus" water from the Colorado River to implement this plan. The Department of the Interior and the other basin states have decided that the benefit of implementing California's plan outweighs the risks of increased shortage and other costs associated with drawing down the elevation of Lake Powell and Lake Mead, and so agreed to create temporary rules, known as interim surplus criteria, to allow California to use additional water. Interior claims that this long-term benefit outweighs the potential short-term costs to the environment, such as reduced flows to the Colorado River delta.

The Bureau of Reclamation published a Notice of Intent to develop surplus criteria for Colorado River management on May 18, 1999 (64 Fed Reg 27008). On July 7, 2000, the U.S. Bureau of Reclamation issued a Draft Environmental Impact Statement (DEIS) to analyze the potential environmental impacts of adopting specific interim criteria (65 Fed Reg 42028). On August 8, 2000, Reclamation published a new set of rules, known as the 7 States' proposed interim surplus guidelines (65 Fed Reg 48531).

The adoption of surplus criteria will impact several related Colorado River issues, including the frequency and magnitude of "space-building" and reservoir spill (flood) flows, the availability of water for the delta region, habitat availability and quality for federally listed species, off-stream storage, the lower Colorado River MSCP, the availability of surplus flows for Mexico, recreational uses along Lake Powell and Lake Mead, water quality issues, power generation, the probability of shortage conditions on the river, and others. The Pacific Institute's comments focus on the scope of the DEIS, potential impacts to habitat along the Colorado River downstream of Lake Mohave, modeling assumptions, and several procedural issues.

The Pacific Institute identifies several significant deficiencies in the DEIS:

1. **The DEIS does not include the 7 State Plan** The DEIS fails to analyze the potential impacts of the 7 State Plan, which is likely to be the preferred alternative. Comments by various basin state representatives at the August 16th Annual Operating Plan (AOP) meeting in Las Vegas indicated that the basin states already assume that the 7 State Plan will be adopted. Yet the DEIS uses a different plan as a proxy for the 7 State Plan, justifying its decision because a "preliminary review" of this plan suggests that it lies "within the range of alternatives and impacts analyzed in the DEIS." A preliminary review by the Pacific Institute indicates that the new, unanalyzed plan would increase Colorado River depletions, exacerbating the potential impacts relative to the proxy plan and to the baseline. The Pacific Institute recommends that these impacts be modeled and analyzed.
2. **Scope** The scope of the DEIS is inadequate. The DEIS does not analyze the full range of potential impacts within the U.S., arbitrarily excluding the limitrophe division of the Colorado River. Additionally, the discussion of transboundary environmental impacts are cursory and

1: Reclamation agrees and has modeled and analyzed the Basin State Alternative for this FEIS. It should be noted that this alternative has been selected as the preferred alternative.

2: The area of potential effect has been expanded to include consideration of the Colorado River 100-year floodplain to the SIB. The Transboundary analysis has been modified in the FEIS and Reclamation believes this section appropriately assesses potential effects in Mexico.

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inadequate. The DEIS fails to acknowledge the potential impacts to the Upper Gulf of California, the listed species found there, and the socioeconomic values dependent upon flows to the Gulf. The Pacific Institute recommends that the scope be extended to encompass the estuary at the mouth of the Upper Gulf and the full floodplain in the Colorado River delta.

3

3. **Modeling Assumptions** The model is based on a series of assumptions that distort the results used to predict potential environmental impacts. These results understate the magnitude of potential impacts to the environmental resources within the affected area. The Pacific Institute recommends that the assumptions be refined, as described in the following.

4

4. **Baseline** The selection of a liberal baseline, based on the 1997 surplus declaration, rather than the more conservative flood control baseline used for the 1998, 1999, and 2000 surplus declarations, is inappropriate. The use of this arbitrary, liberal baseline diminishes the projected impacts of interim surplus criteria, effectively understating the magnitude the action. The Pacific Institute recommends that the flood control guidelines be used as the baseline.

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5. **Cumulative Impacts** The DEIS inadequately accounts for cumulative impacts, and then discounts these impacts, in violation of NEPA. The Pacific Institute recommends that the DEIS list and describe the full range of federal and non-federal actions that impact the affected area, and account for these cumulative impacts.

6

6. **Environmental Responsibilities** Long term Colorado River system management objectives require the Secretary to "protect and enhance the environmental resources of the basin." The adoption of the interim surplus criteria, particularly the 7 State Plan, would not satisfy this objective. An alternative submitted to Interior by the Pacific Institute and nine environmental organizations would meet both the stated objectives for interim surplus criteria and the Secretary's broader environmental trust responsibilities. The Pacific Institute recommends that Reclamation analyze the potential impacts of this alternative in the DEIS.

7

The general effect of the above deficiencies is to understate the potential environmental impacts of interim surplus criteria. The Pacific Institute concludes that the DEIS is inadequate and should be formally revised and reissued for public comment as a Supplemental Draft Environmental Impact Statement. The deficiencies highlighted in these comments are of sufficient magnitude that they preclude a reasonable assessment of the potential environmental impacts associated with the adoption of interim surplus criteria.

8

More broadly, the Pacific Institute believes that the purported benefits generated by interim surplus criteria do not warrant their environmental costs. These costs could be substantial. By the year 2015, the flood control alternative would generate a 17% greater probability of flows reaching the delta than would the six states' plan, itself likely to generate more flows than the 7 state plan. Because the frequency and magnitude of such flows are closely tied to the reproduction and health of the native riparian vegetation in the region, and indirectly to the myriad of threatened and endangered species that depend on this habitat, this projected reduction in flows is significant. The projected benefits of the interim surplus criteria are less clear. Interior is promoting the surplus criteria as necessary to reduce California's consumption of Colorado River water. Yet California's plan to reduce its use, even under the most optimistic of projections, would not meet the target conservation objective. And California continues to demand additional water, above and beyond that outlined within the 7 State Plan. At the August

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3: Section 3.16.5.3 has been added to the FEIS to provide information on the general potential impacts that the implementation of interim surplus criteria may have on the frequency of excess flows to Mexico as well as the potential resultant impacts to groundwater recharge and salinity South of the SIB. Reclamation does not concur with the suggestions presented under the headings - "Baseline", "Cumulative Impacts" and "Environmental Responsibilities." Reclamation's rationale for using the analyses criteria and type of analysis presented in the DEIS and FEIS are explained and detailed in these documents. See responses below.

4: See response to Comment 57-11.

5: Section 4.2 has been modified and Reclamation believes that it has appropriately addressed potential cumulative effects of the proposed action.

6: An EIS need not consider an infinite range of alternatives, only reasonable and feasible ones and those reasonably related to the purposes of the project that afford a reasoned choice by the decision maker. The rule of reason shall be utilized in development of a range of alternatives. NEPA does not require a separate analysis of alternatives which are not significantly distinguishable from alternatives actually considered, or which have substantially similar consequences. For these reasons Reclamation considered the Pacific Institute alternative but eliminated it from further analysis because part of it did not meet the purpose and need of the proposed action and the remainder of the alternative mirrored the Six States Alternative which was analyzed in depth.

7: Reclamation disagrees with the commentor's opinion that the DEIS is inadequate and should be revised and a supplemental DEIS reissued. Reclamation has followed regulations implementing NEPA and it is accepted practice to update, refine, clarify and make factual corrections to the content and analyses in the EIS resulting from improved data control, public comments, coordination with interested parties and incorporate these changes into the document and circulate it as a FEIS.

8: Comment noted. Section 3.16.6 of the FEIS has been expanded to provide more information on the potential effects of changes in excess flows on habitat and threatened or endangered species in Mexico for each of the alternatives.

9: Comment noted. Please refer to the introduction to Volume III regarding the proposed action and its relationship to California's program to reduce its dependence on surplus water.

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16th AOP meeting, California requested a full surplus declaration for calendar year 2001, including 150,000 acre-feet for agricultural demands, justifying this request as a “transition” into the interim period. The absence of a real “4.4 Plan,” combined with California’s continued failure to reduce its use, suggest that California will not markedly reduce its use in the next fifteen years. In light of these substantial costs and tentative benefits, there is little incentive to condone increased threats to environmental values along the lower Colorado River.

BACKGROUND

On July 7, 2000, the Bureau of Reclamation released the draft environmental impact statement (DEIS) for the adoption of interim surplus criteria for the Colorado River. These surplus criteria are meant to establish specific guidelines to assist the Secretary of the Interior’s determination whether to declare a surplus condition for the river, and to facilitate California’s implementation of measures to reduce the state’s use of Colorado River water from its current use of about 5.2 million acre-feet¹ (MAF)/year to its legal entitlement of 4.4 MAF.

Under a complex institutional arrangement known as the Law of the River, Arizona, California and Nevada are entitled to use 7.5 MAF of water from the Colorado River each year. Of this amount, California is apportioned 4.4 MAF. Most (3.85 MAF) of the rights to California’s water belong to agricultural users, leaving only 0.55 MAF for the 17 million urban users in the greater L.A. and San Diego metropolitan area. Since 1961, California has used an annual average of almost 5.0 MAF, supplementing its entitlement with the unused apportionment of Arizona and Nevada. In recent years, however, Arizona and Nevada have consumed most of their respective apportionments, decreasing the availability of unused water for California.

In the past several years, California has consumed more than 5.2 MAF/year, largely because the Metropolitan Water District of Southern California (MWD) has conveyed nearly 1.29 MAF/year through its Colorado River Aqueduct. The Secretary of the Interior and the other six basin states have pressured California to reduce its demands on Colorado River water down to the state’s legal entitlement of 4.4 MAF. In response to these pressures, the state has drafted the California Colorado River Water Use Plan (available at <http://crb.water.ca.gov/reports.htm>), a loose framework of conservation efforts, groundwater storage, offstream banking, rural-to-urban water transfers, and other programs and projects to meet the agricultural and urban water needs of the state while reducing consumption. Originally, this water use plan was called the “4.4 Plan,” but because it only projects 0.49 MAF of savings in the next 15 years and 0.54 MAF of savings in the next 25 years, it was given its longer but less ambitious title.

Partly in response to California’s demand for additional water as it drafted the California Plan, and partly because of very high reservoir levels and unusually wet hydrologic conditions, the Secretary declared a surplus for the river each year from 1996 – 2000. Authority for the Secretary to declare a surplus stems from the *Arizona v California* Supreme Court Decree (1964). A surplus condition allows the lower basin states to consume water beyond their normal apportionment of 7.5 MAF. California is entitled to 50% of this surplus, Arizona 46%, and Nevada 4%; a state may also use the another state’s unused apportionment. The Secretary

¹ An acre-foot is 325,851 gallons of water, approximately the amount two families of four use in a year. The estimated annual flow of the Colorado River since 1906 is about 15 MAF.

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declared these surpluses through the Annual Operating Plan (AOP) process, with the assistance of representatives of the seven Colorado River basin states (Arizona, California, and Nevada in the Lower Basin and Colorado, New Mexico, Utah, and Wyoming in the Upper Basin), tribal representatives, water users, members of the academic and scientific communities, environmental organizations, contractors for hydroelectric power, and the general public.

PARTICIPATION OF THE PACIFIC INSTITUTE

On June 28, 1999, the Pacific Institute submitted comments on the scope of the National Environmental Protection Act (NEPA) process and the DEIS, urging the inclusion of an assessment of transboundary impacts, among other concerns. In November 1999, Pacific Institute staff met with a senior Reclamation official to discuss our concerns regarding the potential environmental impacts of interim surplus criteria. As a result of this conversation, the Institute coordinated a meeting in Las Vegas on December 16th between representatives of several environmental groups and senior Reclamation staff. Among the concerns voiced at the meeting was the potential for surplus criteria to lower the elevation of Lake Mead, decreasing the frequency and magnitude of the space-building and flood release flows that sustain native riparian habitat along the lower Colorado River, especially in the river's delta in Mexico. Upon Reclamation's request, the Pacific Institute offered to draft a set of interim surplus criteria that reflected the interests and concerns of the environmental community.

In response to the concerns voiced by environmental groups at the meeting, the Secretary of the Interior added language to his keynote address on December 17, 1999 to the Colorado River Water Users Association conference. The Secretary stated that surpluses must be determined and allocated with *no net loss* of environmental benefits (emphasis added), setting an important environmental baseline for interim surplus criteria. The Pacific Institute incorporated the Secretary's environmental baseline into the "Environmental Interim Surplus Criteria for the Colorado River" (DEIS Attachment F) that was drafted jointly with American Rivers, Defenders of Wildlife, Environmental Defense, Friends of Arizona Rivers, Glen Canyon Institute, Grand Canyon Trust, Land and Water Fund of the Rockies, Sierra Club Colorado River Task Force, and the Sonoran Institute, as well as several members of the academic community. These criteria were designed to satisfy the dual objectives of improving the predictability of surplus conditions for water users and facilitating California's reduction in the use of Colorado River water, without causing further harm to the environment. In effect, they integrated mitigation measures into the criteria themselves.

INTERIOR AND THE DELTA

The Department of the Interior has publicly recognized the importance of the Colorado River delta. The Secretary's keynote address reflected this recognition. On May 5, at the Law of the Colorado River conference in Tucson, the Deputy Secretary said that the delta is an issue whose time has come. Less than two weeks later, Interior and its counterpart agency in Mexico, SEMARNAP, signed the Joint Declaration to Enhance Cooperation in the Colorado River Delta. In the Joint Declaration, Interior pledges to "strengthen cooperative action and mechanisms, to improve and conserve the natural and cultural resources of the Colorado River Delta, including the river and associate wetland habitats," and "develop strategies of environmental sustainability," among other actions.

10: Comment noted.

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In an opinion piece that appeared in the *Los Angeles Times* on August 25th, the Deputy Secretary wrote of the CALFED process that

It's also about restoring the watersheds that have borne the effects of water manipulations that were undertaken in a different era, an era that paid little regard to the impact that damming, depleting or diverting rivers and streams would have on downstream water quality, fish and wildlife resources and other environmental values.

These words could have been written about the Colorado River. Yet, while the CALFED plan recognizes and allocates water for environmental needs, the interim surplus criteria do not.

THE COLORADO RIVER DELTA

Historically, prior to the construction of dams, diversions, and other reclamation projects, millions of acre-feet of Colorado River water flowed every year through the Colorado River delta and into the Upper Gulf of California, supporting tremendous levels of biological productivity and diversity. The delta has been degraded as human demands have dramatically reduced the amount of water reaching it. Except for years with unusually high run-off, virtually the entire flow of the Colorado is now captured and used before reaching the river's mouth. However, even without the historic flows, the remnants of the delta and Upper Gulf still comprise the largest and most critical desert wetland in North America, as well as one of the world's most diverse and productive marine ecosystems. In recent years, flood release flows from upstream dams have prompted the re-emergence of ecologically valuable riparian habitat and have been strongly correlated with a rise in the shrimp catch in the Upper Gulf, an indication of the renewed viability of an important estuary. In 1993, Mexico affirmed the importance of the region and designated it a Biosphere Reserve, which has since received international recognition.

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At its upper reaches, the delta is dominated by native vegetation such as cottonwoods and willows, offering more than twice the amount of native riparian habitat found in the entire reach of the Colorado River in the United States from Hoover Dam to the Mexican border. The native riparian vegetation of the lower Colorado River and the delta evolved in response to occasional flood events; such flows must be replicated to ensure the continued viability of these species. The middle extent of the delta contains extensive backwaters filled by occasional floods, providing valuable wetland habitat for migratory birds as well as a myriad of local species. The delta supports several species listed by the U.S. Fish & Wildlife Service, including southwestern willow flycatchers (*Empidonax traillii extimus*), Yuma clapper rails (*Rallus longirostris yumanensis*), totoaba (*Totoaba macdonaldi*) and desert pupfish (*Cyprinodon macularius*), while the river's estuary is home to the vaquita porpoise (*Phocoena sinus*), the world's most endangered marine mammal.

11: See response to Comment 22-8.

12

Currently, the Colorado River delta is largely dependent on flood control releases from Hoover Dam. These waters are released primarily from October through February, to provide flood control storage space. It is important to distinguish between surplus flows, which are released upon declaration of a "surplus condition" in response to the diversion orders of downstream users, and flood flows. Army Corps of Engineers guidelines dictate the release of water from Hoover Dam from August through December to ensure sufficient flood control storage capacity. These releases are known as "space building releases," while releases made after January 1 to ensure sufficient flood control storage capacity are known as "flood control releases." Both are also referred to as "spills." These flows may be diverted by downstream users. It is important to note that the current timing of flood control releases precedes the natural flood regime and

12: See Sections 1.3.6 and 3.3.1.2 for explanations of flood control operations for Lake Mead (Hoover Dam).

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RESPONSES

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therefore offers less benefit for the successful recruitment of native riparian vegetation such as cottonwoods and willows than if these releases more closely mimicked the river's natural flood regime.

THE DEIS**POTENTIAL AFFECTED AREA**

13

The DEIS notes the requirement to assess transboundary impacts, pursuant to Executive Order 12114 and the Council on Environmental Quality Guidelines on NEPA Analyses for Transboundary Impacts, as well as the regulations implementing Endangered Species Act consultations with the Fish and Wildlife Service and the National Marine Fisheries Service. Yet the DEIS states that the potential area of impact extends downstream only as far as the Northerly International Boundary (NIB) (p. 3.2-1). This is inconsistent with the Lower Colorado River Multi-Species Conservation Program (MSCP) planning area, which extends as far south as the Southerly International Boundary (SIB), 23 miles further south. It is also inconsistent with the controlling legal authority noted above. Ironically, Map 3.2-1 of the DEIS identifies the "Area of Potential Effect" as extending below the NIB, below the SIB, as far downstream as the river's mouth at the Gulf of California.

The geographic scope of the DEIS should be broadened as well as lengthened. Below Morelos Dam, the river's floodplain widens toward the south. The entire region within the levees in Mexico should be included as the potentially impacted area, as releases of sufficient magnitude to cause overbank flooding could potentially inundate much or all of this area; the 100-year floodplain is much broader in the delta than it is upstream. The DEIS should list the size of the affected area for each of the reaches of the river examined and include specific vegetation coverages for each area. Much of this information has been compiled by the MSCP for the U.S. reach of the river, and has also been documented for the Mexican region.²

14

Historically, the Colorado River emptied into the upper Gulf of California, creating one of the world's most productive estuaries. As a result of flood control releases in the mid-1980s and again starting in 1997, water again flows into the Upper Gulf. These flows generate measurable ecological and economic benefits. Such benefits would be negatively impacted by the projected reductions in flows due to the implementation of surplus criteria. These impacts should be analyzed in the supplemental DEIS.

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The letter (in Attachment Q) from Arturo Herrera, Commissioner of the Mexican counterpart to the US State Department's IBWC, highlights several other potential impacts resulting from the implementation of surplus criteria, including reduced recharge of the Mexicali aquifer. Annual overdraft of the aquifer is partly offset at present by infiltration from periodic Colorado River flood flows. Absent this periodic recharge, the level of the water table would drop more rapidly, increasing the hydrologic gradient under the border and drawing groundwater from the U.S. Such indirect impacts extend the area of potential effect and should be analyzed as part of the

13: Potential effects on special-status species within the expanded area of potential effect are addressed Section 3.8 of the FEIS. Map 3.2-1 has been revised to more accurately represent the area of potential effect considered within the U.S. as well as areas within Mexico that are addressed in Section 3.16, Transboundary Impacts.

14: See response to Comment 12-8.

15: Reclamation believes that the analysis presented in this section. Section 3.16, Transboundary Impacts, has been modified for the FEIS and adequately and appropriately identifies potential effects of interim surplus criteria in Mexico. Note that Reclamation is committed to working with Mexico to address specific concerns.

² See Daniel F. Luecke et al. 1999. *A Delta Once More: Restoring Riparian and Wetland Habitat in the Colorado River Delta*. Washington, DC: Environmental Defense Fund Publications, pp. 20-29.

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NEPA process. Commissioner Herrera also underscores the potential environmental impacts on the delta resulting from surplus criteria.³

Reclamation dismisses Commissioner Herrera's concerns by stating that "it is not clear that these concerns are a result of interim surplus criteria" (3.16-3). Dismissing these concerns violates the spirit of consultation with Mexico. And, as noted in the DEIS, the selected alternative will alter the frequency and magnitude of flood flows reaching Mexico, indicating that such concerns are in fact real. The supplemental DEIS should extend the area of potential impacts to encompass the full range of potential impacts to the delta region and the Upper Gulf of California, as well as regions indirectly impacted due to reduced recharge of the Mexicali aquifer and the likely increase in transboundary groundwater flows due to increased pumping in Mexico.

DEIS AND HABITAT

16

The DEIS fails to provide an adequate description of the habitat and species composition present along the lower Colorado River in the U.S. and in Mexico below Morelos Dam. The DEIS should provide a map displaying the various vegetation coverages along the river downstream of Mohave Dam, to reflect riparian and wetland habitat present in the various wildlife refuges along the river and within the delta in Mexico. The minimum stage necessary to freshen backwaters along the mainstem of the river and to inundate the floodplain in Mexico should be indicated on the map, along with a projected frequency interval at which these conditions would be satisfied under the different alternatives under consideration. The DEIS offers only generalized information and aggregated acreage estimates, despite the fact that more refined data exist.⁴

17

The DEIS does not address the significant difference in the quantity and frequency of water reaching the delta that the model projects for the flood control alternative and the Six States' Plan. Table 3.16-1 indicates that, in the year 2015, the probability of flood flows reaching the delta is more than 16 percent greater under the flood control alternative than under the Six States' Plan. The reduced frequency of flows to the affected area under the Six States Plan would cause further harm to habitat in the area, subsequently impacting the species that depend on this habitat. The DEIS should analyze these impacts.

18

Section 3.16.6.1 states that reductions in flows below the NIB were instituted through the 1944 Treaty. This statement is incorrect and is likely not what was intended. The Treaty establishes minimum, not maximum, flows. In fact, the Treaty increased the quantity of flows that the U.S. was prepared to deliver to Mexico.⁵ The responsibility for the dramatic reductions in the flow of the Colorado River to its delta, from historic levels of roughly 14 MAF/year to zero in most years, lies with U.S. interests.

CUMULATIVE IMPACTS

19

NEPA requires a cumulative impacts analysis: the cumulative impacts of surplus criteria atop increased upper basin consumption and continued excessive use by California, among other

16: Potential effects on special-status species within the river corridor between Hoover Dam and the SIB are addressed in the BA for ISC/SIAs and have been summarized in Section 3.8 of the FEIS.

17: The EIS discusses these potential effects as necessary to identify the differences between each of the alternatives compared to baseline conditions. Table 3.16-1 has been updated in the FEIS with revised data.

18: Comment noted. Section 3.16.6.1 has been revised to state that "...reductions have been instituted while meeting the requirements of an international treaty and the diversion and use of such treaty water is solely at Mexico's discretion." At least since execution of the Treaty, it is incorrect to state that responsibility for reductions of flows to Colorado River delta lies with U.S. interests alone.

19: See response to Comment 12-5.

³ Note that "álamos" in the Commissioner's letter is correctly translated as "cottonwoods."

⁴ See Daniel F. Luecke et al. 1999. *A Delta Once More*, pp. 20-29.

⁵ Norris Hundley, Jr. 1966. *Dividing the Waters: A Century of Controversy between the United States and Mexico*. Los Angeles: University of California Press.

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actions, can not be dismissed. The DEIS provides less than a page on cumulative impacts (4.2). The cumulative impacts analysis should list and describe all of the federal and non-federal actions that could impact the affected area, including reasonably foreseeable future actions. These listed impacts should then be analyzed in light of the additional incremental impacts posed by the surplus criteria. The DEIS dismisses the potential incremental impacts due to the selection of a preferred set of surplus criteria, stating that "the potential effects of interim surplus criteria are likely to be negligible ..." relative to other actions. This is not an adequate cumulative impacts analysis.

PACIFIC INSTITUTE PROPOSAL

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The "Environmental Interim Surplus Criteria," submitted by ten NGOs and subsequently endorsed by the Center for Biological Diversity and The Wilderness Society, should be analyzed in a supplemental DEIS. These criteria would satisfy the objective of facilitating California's reduction in its use of Colorado River water, without forcing the environment to bear the costs of such actions. Although similar in many respects to the Six States Plan, the Environmental Criteria differ sufficiently to merit appraisal in a supplemental DEIS.

20: See responses to Comment 11-8 and 13-4.

In the following, and per previous conversations and correspondence with Reclamation staff, we offer suggestions as to how best to model the Environmental Interim Surplus Criteria, and suggest several specific projections that should be included in the supplemental DEIS.

Clarifications:

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- Reclamation should model the monthly release schedule under "2) baseline delta flows" so that these delta flows are relatively constant throughout the year
- Reclamation should model the monthly release schedule under "5) delta flood flows" so that 100% of such releases are made from May through July, peaking in June at a ratio of 35%: 45%: 20% (flows in other months would be released by the baseline flow trigger, above)
- Due to difficulties in modeling a Secretarial determination of "No Net Loss," for the purposes of modeling Reclamation should assume that such a determination is made

Differences between the Environmental Criteria ("NGO") and the 7 States' Plan ("States"):

- **Normal elevation trigger:** ≤ 1120.4 for NGO, ≤ 1125 for States
- **Baseline delta flows** 0.032 MAF above elevation 1120.4 for NGO; none for States
- **Partial M&I/Domestic surplus elevation** triggered between 1125 & 1145 for both; for purposes of these modeling runs, the quantities of water released under the two plans are equivalent
- **Full M&I/Domestic Surplus** triggered above elevation 1145. NGO plan equivalent to States' plan with the following exceptions: Total deliveries through the Colorado River Aqueduct would be limited to 1.212 million acre-feet under the NGO plan instead of 1.250 under the States' plan
- **Delta Flood Flows** triggered by Reclamation 70 percent flood control avoidance elevation (70A1) under the NGO plan; no such release under the States'

21: Reclamation has noted the clarifications of the Pacific Institute's proposed interim surplus criteria, and the recital of differences between its proposal and the Seven States Proposal. The revised provisions of Pacific Institute's plan have been included in Attachment F of the FEIS entitled Surplus Criteria Proposal by Pacific Institute.

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cont'd

- **Full Surplus/Quantified Surplus** 70R trigger for both plans, although for the purposes of determining the trigger elevation the NGO plan considers the above delta baseline and flood flows as “uses” and the States plan does not (so the trigger elevation will be higher under the NGO plan). Unlike the States’ plan, under the NGO plan, no water would be made available to California or Nevada for off-stream storage, including groundwater banking, under this tier, and no surplus water would be made available to Arizona for such purposes under this tier.
- **Flood Control Surplus** equivalent for the two plans
- **Shortage Criteria** the NGO plan does not establish shortage criteria

Requested information:

- Probabilities of shortage under the two plans, using the States’ definition of shortage
- Probabilities of delta flood flow releases over time
- Probabilities and projected quantities of flows below all major diversions, under the two plans
- Probabilities and projected quantities of flow released under Partial M&I/Domestic surplus, under the two plans, until year 2016

22: Comment noted.

23

The DEIS states that “the delivery of water to or through Mexico would require modification of the Treaty” (2-3). This is incorrect. The Treaty requires the U.S. to deliver a minimum quantity of flows to Mexico; it does not limit the amount of water the U.S. may deliver. In 1998, the U.S. delivered more than 3.0 MAF over Treaty obligations; in 1984, the U.S. delivered more than 13.8 MAF over Treaty obligations. The development and implementation of interim surplus criteria are subject not only to the demands of California and the basin states, but to the Law of the River and the laws of the United States, including NEPA and the ESA. Within this broader context, the proposed environmental surplus criteria are appropriate. Reclamation and the basin states will likely come to find that the limited dedication of resources for environmental purposes outlined in the environmental criteria are far more benign than the mitigation that will be required should they choose to ignore environmental impacts in the U.S. and Mexico.

23: See response to Comment 18.

MODELING

The adoption of interim surplus criteria would create a new set of operational instructions for managing the river; it would not require the construction of new infrastructure. The direct environmental impacts of such criteria would be limited to the effects of changes in river operation. To project the potential impacts of such changes, Reclamation created a basin-wide model that uses the historical record (since 1906) of Colorado River flows to predict future inflows to the system and releases from Lake Mead. As noted by Reclamation, the results of the model are most sensitive to projections of future inflows, the least reliable data. The accuracy of the model also decreases the further it projects into the future. Reclamation contends that the main value of the model is that it allows for an analysis of the relative impacts between the proposed alternatives, rather than an analysis of the absolute impacts of any one alternative.

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RESPONSES

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These comments address three general aspects of the model: the assumptions common to all alternatives, the assumptions for specific alternatives, and the presentation of the model results. There are five assumptions common to all alternatives that should be refined:

24: See the response to Comment No. 31-8 for a discussion of the Index Sequential Method. Other methods are possible, and Reclamation is evaluating them for future use.

25: See response to Comment No. 14-10 for information regarding depletion schedules used in the FEIS.

26: The projected Lake Mead elevation on January 1, 2002 was used for the initial condition in FEIS modeling. See response to Comment No. 13-22 for further discussion.

27: The following excerpt will be added to Section 3.4.3.6 to address the Mexico water supply delivery requirements under Minute 242: Minute 242 provides, in part, that United States will deliver to Mexico approximately 1,360,000 acre-feet (1,677,545,000 cubic meters) annually upstream of Morelos Dam and approximately 140,000 acre-feet (172,689,000 cubic meters) annually on the land boundary at San Luis and in the limitrophe section of the Colorado River downstream from Morelos Dam. It should be noted that while a portion of Mexico's 1.5 maf annual apportionment is actually delivered below Morelos Dam, the entire delivery to Mexico was modeled at Morelos Dam. This basic assumption, while different than actual practice, served to simplify and facilitate the analysis of water deliveries to Mexico under the baseline conditions and surplus alternatives.

28: See response to Comment No. 11-14 for a discussion of the FEIS assumption that the Yuma Desalination Plant will begin operations after 2022.

24 1. **Inflows** Even over the brief historical record, the yearly natural flow of the Colorado River has varied dramatically, ranging from an estimated low of 5.0 MAF in 1977 to an estimated high of 23.6 MAF seven years later. It is not clear that the Index Sequential Method (ISM) used in the model captures the full range of future variability, particularly for the brief 15 year duration of the surplus criteria. We suggest using a partially random model, one that inputs all of the possible permutations of the historical record, to increase the range of possible flows during the interim period.

25 2. **Upper Basin Consumption** The model uses 1996 projections of upper basin consumptive use. These projections reflect a maximum probable rate of increase. As noted by Reclamation at its Hydrological Modeling meeting (8/15/2000), upper basin diversions (and consumptive use) are subject to flow variability because many of them are run of the river diversions, rather than diversions from stable reservoirs, decreasing the likelihood that diversions will match projected demand. The model should incorporate most probable and minimum probable rates of increase for upper basin consumptive use, and Reclamation should assess the sensitivity of the results to differences in such projections. Such rates of increase affect the quantity of inflows to Lake Mead and therefore projections of Mead elevation, important for projecting flood releases flows, shoreline impacts, and probabilities of shortage conditions.

26 3. **Initial Mead Elevation** The model uses as a starting condition the elevation of Lake Mead on January 1, 2000. To improve the accuracy of the model, we recommend that this starting elevation be changed to reflect the projected Mead elevation on December 31, 2000, currently expected to be about thirteen feet lower than the previous year's elevation due to lower than average inflows. This significant drop in elevation will decrease the probability of water reaching the delta region.

27 4. **Deliveries at NIB** The DEIS notes that the U.S. delivers approximately 0.14 MAF/year to Mexico at a location one mile east of the river at the SIB. Yet the model assumes that this delivery occurs 23 miles north, within the river channel. The model should be refined to account for the different delivery points, the fact that the SIB delivery is not made within the river channel, and the fact that the SIB deliveries are return flows from Arizona and not mainstem water. This modeling assumption distorts projected flows through the limitrophe and further downstream, and also distorts projections of maximum probable diversion by Mexico through its Alamo Canal at Morelos Dam.

28 5. **Yuma Desalting Plant** The model assumes that the Yuma Desalting Plant will be operational in the year 2015, yet fails to account for the impacts such an action would have on the Cienega de Santa Clara. The Cienega currently relies on agricultural drainage flows that bypass the desalting plant; operation of the plant would not only markedly decrease the quantity of flows to the Cienega but would also markedly decrease the quality of the water sent to the wetlands, destroying habitat of special status species such as the Yuma Clapper Rail and Desert Pupfish. The DEIS should explain why it assumes operation of the Plant in 2015 and should not ignore the environmental impacts of such an action. Alternatively, and more appropriately, the DEIS should not assume operation of the plant until the appropriate environmental documentation has been completed.

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- 29 | 6. **Climate Change** For the purpose of increasing the accuracy of longer-term projections, the model should incorporate the range of potential impacts of climate change on the Colorado River basin, which might reduce inflows by as much as 20 percent.⁶

The assumptions behind the various alternatives differ in some respects. These varying assumptions inform the projections of the alternatives' relative impacts. The DEIS bases much of its analysis on the relative difference in flows under the different alternatives, making the assumptions behind these alternatives especially important. Reclamation should clarify the following points:

- 30 | 1. **Baseline** NEPA requires consideration of a "no action" alternative, to serve as a baseline for comparison. To date, no formal surplus criteria exist to act as such a baseline. The Secretary, acting without formal guidelines or criteria, has declared a surplus condition for the river each year starting in 1996. Hydrologic conditions have varied considerably over the five years in which surplus has been declared, to the extent that in 1996 insufficient volume was deemed available to provide surplus for Mexico, while in 1998 more than 3.0 MAF were released above downstream demands. Reclamation determined that a "75R" strategy offered the best approximation of conditions on the river at the time of the Secretary's declaration in 1997. The DEIS fails to explain why Reclamation selected 1997 as the baseline year. Selecting 1996 as the baseline would have generated a much more liberal definition of surplus, while selecting the years 1998-2000 would have matched a flood-control definition of surplus (2.2.1.4). Reclamation should explain why it used a single year as the model for the baseline condition, rather than the three years that followed. Although not markedly different than the 75R baseline, a flood-control baseline would generate a greater frequency and magnitude of flows to the delta than the 75R baseline and a 16.7% greater chance of flood flows than the Six States alternative in 2015.
- 31 | 2. **California Consumptive Use** As shown in DEIS Attachment G, the 75R baseline and the flood control alternatives assume that California will only consume roughly 4.4 MAF/year. In comparison, the six states' plan assumes California will consume more than 5.2 MAF at full surplus, and 5.0 MAF decreasing to 4.7 MAF at the Level 2 surplus tier. Yet the main impetus for the creation of interim surplus criteria is to reduce California's use to 4.4 MAF/year. If California were only consuming 4.4 MAF/year, as assumed by the baseline, there would be no need for interim surplus criteria. It is inconceivable that California will reduce its use by more than 0.8 MAF in one year. The baseline/"no action" alternative therefore does not accurately reflect actual conditions.
- 31 | 3. **Six vs. 7 State Plan** The 7 State Plan is the consensus approach submitted by the Colorado River Basin states and therefore will very likely be the preferred alternative. Reclamation claims that the 7 State Plan (65 Fed Reg 48531) is substantially similar to the Six State Plan that is analyzed in the DEIS, and that it does not require its own analysis. The differences between the two plans therefore demand scrutiny, to assess whether the DEIS analysis of the Six State Plan is a reasonable proxy for what is likely to be the preferred alternative. The

⁶ See L. Nash and P. Gleick, 1991, The sensitivity of streamflow in the Colorado basin to climatic changes, *Journal of Hydrology* 125: 221-241 and L. Nash and P. Gleick, 1993, The Colorado River Basin and Climatic Change: The Sensitivity of Streamflow and Water Supply to Variations in Temperature and Precipitation, Washington, DC: US EPA, EPA230-R-93-009, 121 pp.

29: There is not yet a consensus in the scientific community regarding whether long-term climate change will result in overall wetting or drying of the Colorado River Basin. The use of the Index Sequential Method captures a wide range of flow conditions that enables the evaluation of future water supply conditions under different hydrologic scenarios. See the response to Comment No. 31-8 for a discussion of the Index Sequential Method.

30: Reclamation did not use only a single year as the basis for the baseline in the DEIS. See the response to Comment 57-11 for an explanation of the derivation of the baseline.

31: Reclamation's statement that the Seven States Proposal was substantially similar to the Six States Alternative was a conclusion about the need for a preliminary analysis to accompany the DEIS. The preferred alternative has been derived from the Seven States draft proposal, and has been analyzed in this FEIS at the same degree of detail as the other alternatives.

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following simplified table depicts specific differences between the two plans in their prescribed surplus deliveries to California:

Surplus Tier	Six States	7 States
Partial M&I for MWD	0.304 MAF ⁷ , less new transfers	0.262 MAF
Full M&I for MWD	0.554 MAF ⁷ , less new transfers	0.700 MAF

There are also programmatic differences between the two plans. The 7 State Plan is likely to increase consumptive use by California, further decreasing the elevation of Lake Mead and further decreasing the frequency and magnitude of excess flows reaching the delta and Upper Gulf.

The data generated by the model should be presented in a clear manner that conveys pertinent information to the reader. Model results should be refined as follows:

1. **Annual Scale** Much of the specific data in the DEIS is presented only for the years 2005, 2015, 2025, and 2050, providing only two data points for the interim period. At a minimum, the DEIS should present actual data for 1999 as a historical reference, and then project flows for the years 2000, 2005, 2010, and 2015, in addition to the longer-range projections, to provide the reader with a more precise understanding of the potential impacts of the various alternatives.

2. **Seasonal Scale** The DEIS projects monthly releases as proxies for seasonal flows to the delta. However, the months selected to represent seasonal flows (January, April, July, and October) do not reflect maximum discharge rates. The maximum quantity of flows to the delta in 1997, for example, occurred in the months of February, August, and September. Months should be selected based on their ability to represent maximum and minimum flows to the delta.

3. **Instantaneous Discharge** To provide a more accurate picture of transboundary impacts, the model should be adjusted to project instantaneous releases. Such discharge rates can be readily converted to river stage, allowing for an assessment of the potential to freshen backwaters in the U.S. and inundate the floodplain in Mexico below Morelos Dam. Both of these actions are critical for protecting and enhancing existing wetland and riparian habitat. Additionally, the DEIS states that uncertainty about water use in Mexico challenges efforts to predict potential effects of transboundary flows. The Pacific Institute agrees that it is reasonable to assume that Mexico will continue to maximize its consumptive use of Colorado River water. This use could be predicted by comparing the conveyance capacity of the Alamo Canal with instantaneous flow rates above Morelos Dam (effectively a run of the river diversion).

4. **Figures** The DEIS should clearly indicate the differences between the various alternatives under consideration. Many of these differences are slight and tend to be lost at the resolution displayed in the graphs in the DEIS. Figures 3.3-21a-d, for example, would benefit from limiting the x-axis to those values between 75% and 100%, which would enable the reader to draw a better distinction between the alternatives. Additionally, the DEIS incorrectly claims that the highest frequency of flows to the delta is expected to occur under the Six States

⁷ Includes 0.108 MAF IID-MWD transfer (1999 level).

32: Figures and text were provided in the various sections of the DEIS and FEIS that describe current and historical conditions, many on an annual basis.

33: See response to Comment No. 13-27 for a discussion of seasonal analyses.

34: See response to Comment No. 13-28 for a discussion of model time steps.

35: Comment noted. All tables and figures have been updated to reflect data modeled for FEIS, and have been made more readable. The incorrect statement regarding frequency of flows to Mexico being greater for the baseline and flood control alternatives has been corrected.

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Alternative (3.3-44). As shown in Figs. 3-3-21a-d, both the baseline and flood control alternatives would generate more frequent flows to the delta than the Six States Alternative.

7 STATE PLAN

The DEIS does not analyze the 7 State Plan, so its potential impacts can only be estimated from the projections for the Six State Plan. Beyond this failure to satisfy NEPA guidelines, there are several shortcomings associated with the 7 State Plan itself. Chief among these is that it does not require that California reduce its use from current levels of roughly 5.2 MAF/year to the state's legal entitlement of 4.4 MAF/year, a reduction of 0.8 MAF/year. Instead, the 7 State Plan states that California expects to implement projects generating 0.38 MAF of savings by 2011, 0.49 MAF of savings by 2016, and 0.54 MAF of savings by 2026, though it fails to provide a baseline for measuring such savings. Absent such a prescribed baseline, we assume that the savings will be measured against current levels of consumption. Yet this suggests that California will fall far short of the 4.4 MAF objective that is being promoted as the rationale for accepting greater depletions of Colorado River water and further harm to the environment.

The long-term Colorado River system management objectives require the Secretary to protect and enhance the environmental resources of the basin. Yet clause III.3.(f) of the 7 State Plan would preclude releases of water for any purposes other than those outlined in the Plan, including potential releases for the Lower Colorado River MSCP or releases to the Colorado River delta. This clause of the 7 State Plan is invalid and should be deleted. The *Arizona v. California* Decree (1964) established the Secretary of the Interior as River master and vested in him federal control of the Lower Colorado River. The states lack the legal authority to prohibit releases for other purposes.

SECRETARIAL DISCRETION

Allocation of surplus water, over and above the basic lower basin apportionment, is a discretionary function of the Secretary that can and should be exercised consistent with other responsibilities incumbent upon him for allocating the benefits of the river, planning its use, and protecting its resources. Past decisions on development, basic allocations, and operations were made before most of those other responsibilities had been articulated under laws and policies of the United States. This has resulted in serious environmental harm. Given this situation, the Secretary can and should use his discretion in this more enlightened era to the maximum extent possible to ensure that his decisions result in no further harm and, wherever possible, in an improvement of environmental quality.

Environmental needs must be met before any quantity of discretionary water is dedicated to consumptive uses. Until then it is not truly "surplus." Environmental losses were perhaps unfortunate consequences of the basic allocations embedded in the Law of the River and related development; but they need not be perpetuated when the Secretary has discretion over whether and when to allocate additional water. The Secretary recognized as much when he insisted that the surpluses must be determined and allocated with no net loss of environmental benefits.

36: The Seven States Proposal is identified as the Basin States Alternative/Preferred Alternative in the FEIS. The Basin States Alternative has been evaluated in this FEIS. Several particular sections of the Basin States Alternative, including III.3.(f) have not been incorporated in the Basin States Alternative/Preferred Alternative.

37: The Secretary, under the powers vested by Congress in Section 5 of the BCPA, as confirmed by Section II(B)(2) of the 1964 Decree, has certain discretionary authority to determine whether any year is a surplus, normal or shortage year. When more than 7.5 maf of Colorado River water is available for consumptive use during a calendar year in the three lower Division States, this is a surplus determination. Pursuant to the Decree II(B)(2), if sufficient mainstream water is available for release to satisfy annual consumptive use in excess of 7.5 maf, such excess consumptive use is surplus, and 50 percent shall be apportioned for use in California, 46 percent apportioned for use in Arizona, and 4 percent for use in Nevada. When making a surplus determination, the Secretary must apply the criteria in the Long-Range Operating Criteria (Section 602 of P.L. 90-537) in development of the Annual Operating Plan.

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SocioEconomic Impacts

38

The DEIS fails to address the potential socioeconomic impacts of interim surplus criteria. The few remaining Cucapá living in the affected area, who traditionally subsisted on Colorado River fish and endemic grains, depend on Colorado River flows.⁸ Decreasing the frequency and magnitude of these flows will negatively impact the Cucapá. Additionally, Colorado River flows are correlated with improved yields in the shrimp and fish harvests in the Upper Gulf of California,⁹ a major source of employment in the area.¹⁰ The reduced frequency and magnitude of such flows due to the sole and cumulative impacts of surplus criteria will have negative economic repercussions on fishermen and others in the affected area. These impacts should be assessed as part of the DEIS.

CONCLUSION

The Pacific Institute concludes that the DEIS is inadequate and should be formally revised and reissued for public comment as a Supplemental Draft Environmental Impact Statement. The deficiencies highlighted in these comments are of sufficient magnitude that they preclude a reasonable assessment of the potential environmental impacts associated with the adoption of interim surplus criteria.

38: The DEIS and FEIS include a section on "Environmental Justice" (3.15) for purposes of addressing potential economic and social impacts on minority and low-income populations. Executive Order 12898 establishes the achievement of environmental justice as a priority, but this direction is specific to minority and low-income populations in the United States. No socio-economic effects are anticipated due to implementation of any of the interim surplus alternatives. In addition, the transboundary impacts section of the EIS, which addresses impacts to natural resources on Mexico, does not anticipate any adverse effects to sensitive biological resources along the river in Mexico. This includes potential impacts to commercial or subsistence harvesting of shrimp, fish or crops in Mexico.

⁸ Daniel F. Luecke et al. 1999. *A Delta Once More*, pp. 7-8.

⁹ Manuel S. Galindo-Bect et al. 2000. Penaeid shrimp landings in the upper Gulf of California in relation to Colorado River freshwater discharge. *Fisheries Bulletin* 98:222-225.

¹⁰ Jason Morrison et al. 1996. *The Sustainable Use of Water in the Lower Colorado River Basin*. Oakland, CA: Pacific Institute for Studies in Development, Environment, and Security, p. 23.